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Remarks on some species of PALUDINA, AMNICOLA, VALVATA, and MELANIA.

BY JAMES LEWIS, M. D., MOHAWK, N. Y.

AMNICOLA (PAL.) LIMOSA, Say. Soft parts.

Foot seen below, truncate anteriorly, with acute angles laterally, the foot being constricted. Back of the constriction the foot dilates to nearly or quite the width of the anterior, the sides being parallel, thence posteriorly about 1½ diameters of the foot; posterior termination an abruptly-shortened wedge. Colors variable. In some specimens there are longitudinal strips of flesh color on the inferior surface of the foot, widest behind the constriction, and growing narrower posteriorly. Between these strips is a wider area of slate color, with a few faint granulations. In other specimens the foot is bordered with white on each side, the flesh color of the preceding variety being replaced with what appears to be a band of compact granulations, which become less numerous posteriorly; a few are seen in the central portions of the foot, where they appear to be embraced in the parenchyma of the foot. Other specimens are observed in which the visible soft parts are of a very uniform salmon color without any observable markings on the surface. In these the bands which appear on the mantle of other specimens, visible through the shell, are absent.

No obvious markings have been detected on the superior surfaces of the foot in any instances. A few specimens, however, in favorable light, present slight markings on the superior lateral portions of the foot, too indistinct to have a name.

The rostrum seen below has a strongly-impressed central line, which extends over its anterior extremity. In most instances the superior surface of the rostrum has a dark longitudinal strip extending from the head forward, growing indistinct and becoming lost before the extremity is reached. Each side of this dark strip is an interrupted and not very well defined line of light colored or yellowish granulations. The lateral portions of the rostrum are marked by a dark strip that becomes more dense and broader as it recedes along the sides of the head beneath the tentacles. These strips are more variable than the central strip.

The tentacles are directed obliquely forward and are nearly parallel. They are not always equally developed, being sometimes malformed; the malformations usually manifested are slight deviations from a right line, with contractions in length. Either tentacle may be seen to be affected in this way, and sometimes both. In a considerable number of specimens, the inferior surface of the tentacle presents a well-defined black line extending from the base to near the tip. This line is not always present in both tentacles, and seems to be more frequently wanting in the right. It is sometimes irregularly interrupted, and may be so in one or both tentacles. When interrupted, the tentacle may also be seen to present other irregularities. The eye is obviously inserted in the dilated base of the tentacle, and less obviously in the head at the base of the tentacle.

Neck of the animal large and robust; superior lateral portions of the foot and neck without fold or sinus.

In younger specimens the general appearances are the same, except that the foot presents rounded lateral and posterior outlines, and the foot is usually a little smaller in proportion to the size of the shell. The movements of the animal are quite brisk, and free from hesitation, and have the graceful, gliding motion peculiar to the genus.

AMNICOLA (PAL.) GRANA, Say.

Paludina lustrica, Ad. (Thompson's Vermont.)

Shell thin and translucent, form paraboloid, the apicial whorls having a greater angle than those forming the body of the shell.

Dimensions variable. In the Mohawk River, adults are often 3-16th inch in length. In other localities it is usual to find them much less.

Soft parts seen through the shell orange or white, with one or more irregular bands like the preceding species.

External soft parts—Inferior surface.—Foot as long or a little longer than the shell, anterior truncated and rounded. The anterior lateral angles formed by the constriction of the lateral portions of the foot as in other species. The middle of the lateral portions of the foot expanded, growing narrower posteriorly and terminating in a rounded extremity. Anterior portion white, with a translucent border; posteriorly granulated with numerous, crowded, minute white points. Tentacles diverging in front of the anterior margin of the foot. Rostrum extending about half as far as the tentacles beyond the foot. Superior surface. External soft parts nearly all white and translucent: eyes black and set close to the base of the tentacles; between the tentacles is a longitudinal strip of dark brown, which fades to orange on the base of the rostrum. Scarcely any granulations, or other markings appear on any of the superior surfaces.

MELANIA SUBULARIS, Lea. Soft parts.

Inferior surface of foot salmon colored, with a narrow, well-defined border of lighter tint around the semicircular anterior margin, within which is a wider band of a deep flesh color.

The superior surface of the foot orange-colored; the anterior portion presenting a deeper tinge, with numerous well-defined black lines parallel with the anterior margin, but separated therefrom by a zone of the same tint, as the narrow margin of the inferior surface.

The superior lateral portions of the foot are marked with irregular anastomosing black lines, which preserve a general parallelism with the margins of the foot, but frequently terminating downwards in the lateral margins of the foot; toward the neck the anastomosing lines embrace numerous areas of granular surface, in which the granulations are not strongly marked. The rostrum inclines to a yellowish tinge, and is marked by numerous fine black transverse lines, which are least developed on the superior lateral portion of the rostrum near the middle of its length.

The anterior and a narrow lateral portion have a lighter appearance. The tentacles present a faint greenish tint, and are marked near their tips with dark bands, presenting a jointed appearance. The tentacles are small and somewhat elongated. The eye appears as a small but well-defined black spot at the apex of a rounded but not very elevated tubercle, growing out of the head and posterior of the base of the tentacle, a little above a line connecting the axes of the tentacles at their insertion.

The lateral portion of the foot presents a vertical sinus or fold extending up along the neck from the constricted portion of the foot behind the angular termination of the rounded anterior. The existence of this sinus permits the foot to be largely extended. The color of the external soft parts is not uniform in a series of specimens, though the form and the black lines are constant. In some specimens there are scarcely any traces of orange or flesh tints. In these the soft parts are more translucent, and the inferior portion of the foot is white, with a blue tint, resulting from translucency. The parts within the shell are sometimes yellow or orange, and those of the apicial whorls sometimes green. The motions of the animal in progressing are irregular.

The foot is elongated, the shell remaining stationary; the posterior portion of the foot is then contracted, and the shell pulled forward. At this point the foot presents an outline.

These movements are sometimes changed, and the animal advances by an apparent gliding motion of the whole foot; more usually the progressive movements are an alternate expansion and contraction of the foot.

This *Melania* abounds in the Mohawk River, preferring sloping, muddy banks in eddies, where there is little current.

MELANIA EXILIS, Haldeman.

The shells of this species are quite variable in form and color, so much so as to have drawn from a distinguished zoologist the inquiry if they might not be more than one species.

Some are elongated and slender, with scarcely any angularity on the larger whorls below the carinated apicial whorls; others are more robust, with a wider apicial angle, with a tendency to form gibbous enlargements of the last whorl. In these there is an obsolete angle between the base of the shell and the surface of the spire. The soft parts present some diversity of color, as is the case with all the univalves of this class observed in the Mohawk River, (except *Valvata tricarinata*, which is pretty uniformly white.) There are, however, constant features which seem to characterize the species.

Specimens in which the prevailing tints of the soft parts are salmon or orange, have the anterior margin of the inferior surface of the foot marked with a not very well-defined border of orange, which is darkest where lightest in the preceding species; back of this, and covering nearly the whole bottom of the foot, is an area of purplish slate color, surrounded entirely by a narrow orange or salmon margin, which is not well-defined, except as limited by the margin of the foot.

In other specimens of lighter color, no obvious zones appear, the anterior being pale, nearly white, and the translucency of the posterior parts permitting a faint reflection of the operculum and shell to be seen through them, presents a darker appearance. In some instances the variety of color is diversified, and presents a faint purplish slate-colored area of horse-shoe shape within a border of lighter color forming the posterior margin of the foot.

The superior surface of the foot near the anterior margin is marked with a few black lines, parallel with the margin. Back of the angle of the foot these lines are limited to a narrow zone along the lateral margin of the foot, where they are irregular and inosculate with each other, and frequently terminate downward in the margin of the foot. Approaching the neck, after leaving the lineated margin of the foot, the surface presents a beautiful granulated appearance, from the effect of numerous, minute, brilliant yellowish or orange spots (of a faint greenish tinge), irregularly yet densely distributed over a surface of greenish black. There is no appearance of *sinus* or *fold* in the margin of the foot and side of the neck.

The rostrum is wider and shorter than in the preceding species, and presents a very robust appearance when the two species are compared. The upper surface is marked with numerous well-defined transverse black lines; between these the prevailing color of the surface is salmon or orange, with a dirty greenish tinge. Usually the end of the rostrum is of a green tint, like that produced by certain salts of copper when combined with organic matter. This color is seen whether the parts are inspected from above, below, or in front. One specimen in which this feature was absent presented all the other prominent characters of the species.

The tentacles are large at their base, less elongated and not so slender as in the preceding species. At their base they are surrounded by a dense band of brownish black, well-defined towards the head, but fading away indistinctly on the side towards the end of the tentacle. This band is constant, and seems to be characteristic. The tentacles are usually of a beautiful ruddy salmon color, lighter near the tips, where the surface is quite regularly marked with black bands, imparting a jointed appearance to these organs. These bands, when closely inspected with a powerful lens, give the tips of the tentacles a ciliated appearance, resulting from the manner in which the bands are arranged. The bands are well-defined on the side toward the base of the tentacle, but fading away into linear patches towards the tip.

In half-grown specimens the tentacles are more slender and elongated, with more numerous bands extending often beyond the middle towards the head. Occasionally a specimen may be seen in which the tentacle terminates in a not very well-defined bulb, approaching in appearance the eye-bearing tentacles of *Helices*.

The eye is situated on the apex of the tubercle placed against the posterior of the base of the tentacle, and appears larger than in the preceding species, at the same time giving a massive feature to the head. The pupil of the eye is a well-defined black spot, surrounded by a bright yellowish surface, which is again surrounded by a darker area extending down the sides of the tubercle. The motions of the adult are slow, and seem to be regular and continuous: younger specimens move more rapidly, and are observed more frequently to drag the shell by an interrupted motion than the adult; but no elongation and contraction of the foot has been noticed in either young or adult, as in the preceding species.

This species is found abundantly in the Mohawk River, in places where there is considerable current, adhering to hard, dry banks, stones, sticks and aquatic plants. It is seldom found associated with the preceding species—their habits being quite unlike.

The following features of the two species above considered may suffice for placing them apart in subgenera:

1. The presence of a sinus or fold in the sides of the foot and neck of *M. subularis* and its absence in *M. exilis*.
2. The extension of the anastomosing black lines from the margin of the lateral portions of the foot upwards along the side of the neck in *M. subularis*, and the restriction of these lines to a narrow zone along the lateral portions of the foot of *M. exilis*.
3. A well-defined dark band around the base of the tentacle in *M. exilis*; not observable, or at most only faintly indicated, in *M. subularis*.

CYCLOSTOMA LAPIDARIA, Say.

The soft parts of this animal have been observed, and notes in relation thereto have appeared in the Proceedings of the Boston Soc. Nat. Hist. It may be well to apply here a few inadvertent omissions.

The rostrum is proportionally larger than in *Amnicola* and has the appearance of *Melania*, being marked with well-defined transverse black lines. The tentacles are proportionately large, and, instead of being directed obliquely forward, droop and form an angle near their middle. The eye, instead of being placed in a tubercle at the base of the tentacle, is placed in a tubercle, surrounded by a well-defined and elevated process, presenting the appearance of a cup or ring around the eye tubercle, which ring at its anterior side unites with the base of the tentacle. The motions of the animal are entirely unlike *Amnicola* (in which genus this mollusc has been included by late writers who have examined the shell only,) and are very much like the movements of *Melania subularis*, only that it exhibits more uniformly the expansions and contractions of the foot in progressing, and also exhibits a very positive halt at each movement. Its progress in moving is slow and irregular. The shell is not carried obliquely erect as in *Amnicola* and *Paludina*, but drags behind the foot as in *Melania subularis*, and is hitched along in the same manner. A figure of the soft parts of *Truncatella* in the Supplement to Terr. Moll. by W. G. Binney is a better illustration of this mollusc than any figure of *Amnicola* yet published.

This resemblance, together with an agreement in habit with *Truncatella*, suggest that the mollusc now under consideration may properly be set apart under a separate generic designation between *Truncatella* and *Melania* if it be not retained in *Melania*.

It certainly cannot be retained in *Amnicola*, as its external anatomy is too unlike that of *Amnicola* in any respect to sanction such treatment.

Inhabiting the waters in various parts of the United States is a small mollusc first noticed by Mr. Say under the name "*Melania isagona.*" Since then it has been assigned by different writers to *Anculosa*, *Paludina* and *Amnicola*. To Mr. Lea is assigned the credit of first surmising the generic place of this mollusc, and an examination of the soft parts of this mollusc in connection with other species of *Amnicola* confirms the correctness of Mr. Lea's decision in placing this mollusc with *Amnicola*. The most marked feature observed in the soft parts of this species when compared with other species of *Amnicola*, is the shortness and width of the foot. In this respect the foot corresponds with the shell. It may be well to remark here, that the length and breadth of the foot in all species of *Amnicola* observed by the writer, correspond to the length and breadth of the shell.

The following notes on *Paludina* have, in part, been some time prepared. Their publication at this time may serve a useful purpose.

PALUDINA INTEGRA, Say, (De Kay.) Soft parts.

The coloring of the external soft parts presents some variety, but less than has been observed in other univalves found in the Mohawk River and Erie Canal. A characteristic specimen exhibits the following features :

Upper surface of foot mottled with numerous coalescing orange spots, more or less brilliant, the interstices being slate color with a faint purple tinge, in a strong light almost black, by contrast with the orange spots. The longer diameters of these spots are directed toward the anterior central part of the foot, causing them to appear somewhat as if radiating from that point. Beneath the shell (on the neck) and anterior to the opercle the surface is nearly destitute of spots, and of a light slate color. On the inferior surface of the foot, the spots are less numerous, smaller and diminishing toward the central line, on each side of which is an undefined space nearly free from spots.

Removed from the shell, the mantle is observed to be densely covered with *pigmentum nigrum*, from the margin bordering the aperture of the shell to very near the last apicial whorl. The parts of the mantle which line the *outer portions* of the shell are more densely covered with pigment than the part embracing the columella.

Embryonic specimens when ready for exclusion are nearly 3-16th inch long, the shell translucent, pale olivaceous and permitting two or three faint black linear bands on the mantle to be seen through it. These black lines subsequently extend, and form the coating of pigment observed on the mantle of the adult. This species, as well as other species of Paludina of this country, (and perhaps this may be observable in all viviparous univalve molluscs, as it certainly is to a greater extent in a genus of air-breathing molluscs of the Sandwich Islands,) affords about two per cent. of reversed specimens among its young. A considerable number of specimens of this species having this character have been found full grown, bearing young. The young in such instances show only a slightly increased percentage of reversed specimens.

It is not unusual to find among the embryonic young of this species, specimens in which the whorls are made to embrace each other, as in *Planorbis*.

Specimens have also been observed in which the whorls were lax and separated from each other. But no living specimens separated from the parent have ever been detected with these features.

Other specimens have been observed in which the whorls are drawn nearer the axis of the shell, making the shell elongated. In these specimens the parts which have been drawn away from the preceding whorls are eroded and the adult presents a curious scalariform appearance under these circumstances.

This species feeds on animal and vegetable food; over one hundred were taken from a decomposing salt cod-fish that had been thrown into the Erie Canal. They have also been found feeding on Uniones recently dead. They are most abundant in locations where refuse food from boats or other sources accumulate in the Canal.

The ovaries are usually free from young only a few weeks in early summer. The number produced by an adult seldom exceeds thirty, and is often less. Specimens have been found 1 9-10th inches long. The usual dimensions of the adult seldom exceed 1 6-10th inches. The proportions of the sexes are somewhat different in this species from those of *decisa* and *rufa*, there being a somewhat greater percentage of males for this species. The females are about eight times more numerous than the males.

Paludina decisa? Say.

Paludina decisa, De Kay.

This seems to be somewhat a stumbling block to naturalists in this country, and writers who have endeavored to elucidate Mr. Say's writings on this species, evidently imitate him in confounding two distinct species. Mr. Say's figure of *decisa* in his American Conchology belongs to a group which embraces *P. ponderosa*, Say, as its type, which species any one acquainted with the soft parts would say is more nearly related to *integra* than to that species which, by common consent among naturalists in the eastern portion of the United States, (and evidently following Mr. Say's earliest types,) is called *decisa*.

The writer of this paper at one time confounded *integra* and *decisa*, and continued in that error until obvious and constant differences from the embryonic young to the adult, forced the conclusion that they were distinct species.

P. DECISA. *Soft parts.*

Spots less numerous than in *integra*, larger, brighter, circular, well-defined, and separate, and not arranged radially as in *integra*.

Mantle white, with scarcely any *pigmentum nigrum*. Embryonic young more numerous than in *integra*; no linear bands of pigment on the mantle. Length ¼ inch. Reversed specimens about two per cent. as in *integra*. No distorted embryonic young yet observed. The reversed young seldom attain half the size of the adult, and specimens have not yet been found with young.

No evidence has been presented that this species partakes of animal food.

Adults of this species sometimes attain a length of 1½ inches—usually less.

PALUDINA RUFA, Haldeman. *Soft parts.*

Upper surface of foot of a dark slate color, almost purple when seen in a favorable light, marked with numerous small disconnected greyish orange spots occupying less of the surface than in *decisa*. Tentacles dark, with a pale margin. Mantle covered with *pigmentum nigrum*.

Embryonic young nearly as large as those of *decisa*, the shell of a decided pink tinge, translucent and with a polished epidermis. This last feature characterizes the shell at all stages of development. Faint markings appear on the mantle through the shell.

The largest adults observed were nearly 1¼ inches long. In these the last whorl presents a flattened surface parallel with the surface of the preceding whorls, with a somewhat well characterized angle between that surface and the base of the shell. The angularity observable below the suture of *integra* is never seen in this species, and the angularity on the middle of the whorl in this species, is not seen in *integra*; *decisa* has no angularities.

Specimens of this species with well-marked bands have been observed. Similar features have also been observed in *integra* and *decisa*, but in these they can be traced to injuries inflicted on the margin of the mantle at an earlier stage of existence, while *rufa* presents these characters as the indications of a variety.

Reversed specimens among the embryonic young do not seem to be as numerous as in *decisa* or *integra*, though they are not rare. They seldom survive separation from the parent. Of many hundreds of specimens taken of all ages, only a single reversed specimen ¼ inch in diameter attests their existence after exclusion. No distorted specimens, either young or adult, have yet been detected.

This species has within a few years been introduced at the points where observed. It prefers to associate with *integra* rather than with *decisa*, and this leads to the supposition that it is carnivorous, though no evidence has been found which is demonstrative of that fact.

The writer has been favored with proof sheets of a Descriptive Catalogue of the species of *Amnicola*, *Vivipara*, &c., of North America, by W. G. Binney. As I do not hope to alter Mr. Binney's views by any sugestions made to him, the following are offered for the consideration of those who might otherwise accord too much to Mr. Binney's somewhat sweeping generalizations.

It is quite probable that many small molluscs, which are at present placed in genera to which they seem most nearly allied by the forms of their shells, will hereafter be separated when their soft parts have been studied. Two instances appear in the preceding papers—"*Amnicola isogona*, Lea," and " ——— (*Cyclost.*) *lapidaria*, Say." Perhaps a third (*Amnicola attenuata*, Hald., 3d page Des. Cat.) deserves consideration, under a future review of *Amnicola*. There are good reasons for believing that the forms of the shells of the various species of *Amnicola* are embraced within limits typified by *A. tenuipes*, Hald., and *A. isogona*, Lea. A species more slender than *A. tenuipes* should certainly have the evidence of the soft parts to confirm its position, and it is unfortunately the case that these are too often passed over hurriedly or entirely neglected.

It is quite probable that "*Amnicola protea*, Gould," will be found not to be an *Amnicola*.

Amnicola (Pal.) *lustrica*, Say, if Mr. Say's remarks on that species are entitled to any consideration, probably covers some such a shell as *Valvata pupoidea*, Gould.

Amnicola granum, Say. This species may perhaps be the same as *Amnicola obtusa*, Lea.

Specimens of this species (*granum*) found in near, but dissimilar, locations, present great variations in magnitude and color.

Mr. Binney's treatment of the several species of Paludina (Vivipara), the apicial whorls of which are carinate, should be modified to conform to the rules he applies to *decisa* and its analogous forms, or he should abandon the position he has assumed with regard to *decisa*. It is quite as plain that *Pal. subcarinata*, Say, should be made to embrace as varieties all the species with carinate apicial whorls as that *decisa* should embrace so many *species* as Mr. B. has assigned to it.

On page 22 of Mr. Binney's paper is a figure of *decisa*, which may be regarded as presenting a tolerable outline of the typical form of that species, as first understood by Mr. Say. On page 23 is a figure of a deformed *Pal. integra*, the malformation resulting from an injury imparted to the margin of the mantle of the animal in an earlier stage of growth. The original specimen from which the figure was made is in the possession of the writer.

Page 24, fig. 37, is a specimen of *P. integra*, in which the whorls are drawn to the axis. The parts which should be applied to the preceding whorls are somewhat drawn away at the suture, and are eroded.

Page 26, fig. 38, is correctly named *Pal.* (*Vivi.*) *integra*.

Page 32, fig. 38, a reversed shell. All our olivaceous species produce this form, and it cannot be regarded as a normal species.

Fig. 40, does not give a recognizable outline of typical *Pal. rufa*, of the size of the figure.

Fig. 43, page 27, refers to a species of shell found in the Ohio Canal at Columbus, Ohio. Other shells of a similar *form* at maturity, from other localities have been confounded with this as *Pal. obesa;* but later investigations referring to the embryonic young and other specimens of various sizes would warrant the conclusion that they were distinct. This shell stands related on one hand to *integra* and *ponderosa*, and on the other to *Pal. regularis*, Lea. The young shells nearly but not quite resemble Mr. Lea's types of *regularis*.

Fig. 44. *Pal. genicula*, is more nearly allied to *integra* than to any other known form.

Mr. Binney has given a figure of the lingual dentition of specimens of *Pal. integra* on page 29. It is to be regretted that minute comparisons were not made between those of *integra* with the teeth of *rufa* from the specimens of the two species which were furnished him by the writer for that purpose.

Mr. Binney is also unfortunate in his treatment of *Pal. coarctata*, Lea. It certainly cannot short of doing violence to the subject be made to embrace *Pal. exilis*, Anth., to which *P. compressa* is here submitted as a synonym.

ERRATA AND ADDENDA.

Page 71, line 9 from bottom, for "chryostictus" read chrysostictus.
73, line 34, for Ialtris read Jaltris.
75, line 7 from bottom, for Ophiomorphus read Opheomorphus.
76, note 3d, for 210 read 180.
77, line 12, add loreal oblong.
77, line 28, for "Haliophis" read Alsophis.
78, line 13, for "epinephalus" read epinephelus.
154, line 11, add after *Halophila*, Gird., (?=*Platymantis*, Gthr.)
154, line 12, add plicifera.
184, line 5 from bottom, add Tympanic orifice distinct.
189, line 34, for 1 in. 9 l. read 2 in. 9 l.
249, line 6, for *Carphoptis Harpesti* read *Carphophis harperti.*
337, line 3 from bottom, for Homeroselaps read Homoroselaps.
337, note, for Falvin read Salvin.
340, line 5, add, although the same parts may usually very early attain completion, thus becoming of great systematic value.
340, line 4 from bottom, add, from Ooroomiah.
340, line 3 from bottom, add Umvoti Zulu Country.
341, line 30, add, from Umvoti Zulu Country.
344, line 8, add, from Ooroomiah.
346, before TESTUDINATA insert CROCODILIA. Jacare latirostris, Gray. Dum. Bibr. iii. p. 86, Buenos Ayres.
350, line 14, add Perhaps the curiyú of Azara, i. 226.
350, line 26, add as shown by Dr. J. E. Gray.
353, line 5, for podicipinus read podicipitinus.
353, line 29, for variabilis read intermedius.
356, line 6 from bottom, and
357, line 21, for Von Martins read Von Martens.
358, between lines 40 and 41, add stermosignatus ex Gthr.
358, line 46, after *Phryne* add Fitz.
359, note, line 9, add perhaps not different from H. baudinii.

The Reports of the Recording Secretary and Curators were read as follows: